portion, a melting cylinder, and a rear-end portion. The tip portion having a weighing chamber with a required length communicating with a nozzle member at a first end and with the melting cylinder at a second end. The melting cylinder having a supply port on an upper side and an agitating and injection means disposed within. The melting cylinder provided obliquely in a manner that a tip portion end is directed in a downward direction so that a molten metal in said melting cylinder flows down by self-weight to be stored in the tip portion. The said agitating and injection means is mounted to rotate or advance or retreat freely. The agitating and injection means is constituted by a rotatable agitating member in which a plurality of agitating wings are formed intermittently about an outer periphery of a tip portion of a hollow shaft that extends the length of the melting cylinder. The agitating wings have an external diameter approximately equal to the inner diameter of the melting cylinder. The hollow shaft having a through-hole at a central position, a separate injection rod, having an injection plunger attached unitarily to a tip of the injection rod, is inserted into the through-hole. The injection plunger is freely slidable in a central portion of the agitating member and extendable beyond the tip of the agitating member so as to insert into said weighing chamber freely. The rear-end portion of the injection mechanism is aligned with and spaced behind an upward end of the melting cylinder and includes a device for driving those agitating and injection means. The injection

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molding machine further includes a mold-clamping mechanism disposed external to and downward from the nozzle member of the tip portion.

Applicant notes that only the Bradley reference shows an in-line injection mechanism, the two Kono references show injection mechanisms having two bores at an angle to each other. The Bradley in-line injection mechanism is designed for thixotropic metals having a viscosity substantially higher than the viscosity of liquid metals. This viscosity allows the metal to be pumped by the screw mechanism. Bradley states (Col. 7, lines 40-41) that pumping of the thixotropic slush is highly inefficient when the slush has 5% or less of solids, i.e. as the slush approaches a liquid. If the Bradley in-line injection mechanism were to be inclined, it would suffer a further problem in that the liquid metal, being much less viscous, would run out from the screw escaping the pumping action and changing the proportion of solids in the thixotropic slush.

The Bradley in-line injection mechanism does not show separate agitator and injecting means as claimed in Claim 1. Bradley utilizes a reciprocable and rotatable extruder screw with a screw tip to move and agitate the thixotropic slush and push the mixture out the injecting tip. This does not suggest the rotatable agitating member made up of agitating wings attached about the periphery of the tip of a hollow shaft mounted in the melting cylinder portion of the injection mechanism or the separate injection rod mounted in the hollow shaft for pushing liquid out the tip portion.

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While the Kono patents do not show an in-line injector, the '372 patent does have a separate agitator and injector. However, these two components are in different barrels of the injector mechanism. Therefore, none of the reference patents, in any combination, suggests the use of concentrically oriented agitator and injector.

The combination of the patents is further contraindicated by the methods of melting the metals. The two Kono references utilize a melting pot where metals of varying sizes are heated until melted and maintained in a liquid state ('372, Col. 3, lines 13-23). In the '976 patent, the liquid metal is supplied to a temperature-controlled barrel where it is maintained at the liquid temperature and pools near the port to the injection chamber (Col. 6, 11.4-16). In the '372 patent, the liquid metal is supplied to a barrel where it is successively cooled until the metal near the port to the injection chamber is cooled to the thixotropic rather than liquid state (Col. 3, Lines 27-41).

In contrast to these patents that start by melting alloys into a liquid, the Bradley patent starts with room temperature metallic pellets, powder or chips, explicitly eliminating the traditional melting pot (Col.2 Lines 55-59). The metallic chips are pushed along a barrel that has heaters arranged along it to raise the temperature of the chips until a thixotropic slush is formed and available to be extruded through the injection tip. Hence, the temperature profiles in the barrel among these three references are each distinct with Bradley showing a steadily increased temperature as the tip is approached, '976 showing a constant

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temperature along the barrel, and '372 showing a steadily decreased temperature as the tip is approached.

Applicant has shown that no combination of the references teaches the separate concentric agitator and injection plunger of Claim 1 and that the in-line injector of Bradley would not work if inclined like one of the barrels of the Kono patents. Further, Applicants have shown that the references use inconsistent heating profiles in the main barrel that would preclude combining the patents. Therefore applicants respectfully request allowance of Claim 1 and all claims dependent on it. The Examiner is encouraged to telephone the undersigned attorney to discuss any matter that would expedite allowance of the present application.

Respectfully submitted,

KIYOTO TAKIZAWA ET AL.

By: Beverly E. Hjorth
Beverly E. Hjorth
Registration No. 32,033
Attorney for Applicants

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
Ten Post Office Square
Boston, MA 02109
Telephone: (617) 542-2290
Telecopier: (617) 451-0313

CLG/jde/271171

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

MARKED-UP VERSION OF ABSTRACT

An injection molding machine for low-melting point metallic material has an injection mechanism having a tip portion, a melting cylinder and a rear portion holding a drive mechanism. The tip portion has a weighing chamber and a nozzle member feeding a mold. The melting cylinder is held at an oblique angle to promote gravity flow of the molten metal toward the tip portion. The melting cylinder encloses an agitating and injection ~~means~~ mechanism that rotates and advances or retreats freely within the cylinder. One agitating and injection ~~means~~ mechanism has a hollow shaft surrounding an injection rod tipped by an injection plunger that moves lengthwise in the shaft and agitating wings disposed around the tip end of the hollow shaft. The wings reach the inner sides of the cylinder and rotate. The plunger may extend beyond the shaft to be inserted in the weighing chamber.

MARKED-UP VERSION OF CLAIM AMENDMENTS

1. An in-line injection molding machine for low-melting point metallic material in which the injection molding machine is constituted by:

an in-line injection mechanism having a tip portion, a melting cylinder, and a rear-end portion;

said tip portion having a weighing chamber with a required length communicating with a nozzle member at a first end and with said melting cylinder at a second end;

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said melting cylinder having a supply port on an upper side and an agitating and injection means disposed within, said melting cylinder provided obliquely in a manner that a tip portion end is directed in a downward direction such that a molten metal in said melting cylinder flows down by self-weight to be stored in the tip portion, said agitating and injection means ~~adapted~~ mounted to rotate, or advance or retreat freely, wherein said agitating and injection means is constituted by an agitating member in which a plurality of agitating wings are formed intermittently about an outer periphery of a tip portion of a hollow shaft that extends a length of said melting cylinder, said agitating wings with an external diameter approximately equal to an inner diameter of the melting cylinder, said hollow shaft having a through-hole at a central position and an injection rod having an injection plunger attached unitarily to a tip of said injection rod inserted into said through-hole, said injection plunger freely slidable in a central portion of the agitating member and extendable beyond the tip of the agitating member so as to insert into said weighing chamber freely;

said rear-end portion aligned with, and spaced behind, an upward end of said melting cylinder including a device driving ~~these~~ said agitating and injection means; and

a mold-clamping mechanism disposed external to and downward from the nozzle member of said tip portion. ~~wherein said agitating and injection means is constituted by an agitating member in which a~~

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~~plurality of agitating wings are formed intermittently about an outer periphery of a tip portion of a hollow shaft that extends a length of said melting cylinder, said agitating wings with an external diameter approximately equal to an inner diameter of the melting cylinder, said hollow shaft having a through hole at a central position and an injection rod having an injection plunger attached unitarily to a tip of said injection rod inserted into said through hole, said injection plunger freely slidable in a central portion of the agitating member and extendable beyond the tip of the agitating member so as to insert into said weighing chamber freely~~.

4. The in-line injection molding machine for low-melting point metallic material according to claim 1, further comprising:

a base supporting said mold-clamping mechanism;

a pedestal on said base spaced apart from said mold-clamping mechanism;

a frame installed on said pedestal having an inclined upper surface incorporating a pair of support shafts at a lower end of said upper surface;

a hydraulic cylinder, spaced a required interval from said upward end of said melting cylinder, said hydraulic cylinder oriented in a downward direction, an upper end of said hydraulic cylinder at a tip portion of said frame; and

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FAX. (617) 451-0313

supporting legs, projecting from a lower side of said hydraulic cylinder said supporting legs inserted respectively in said support shafts; wherein a nozzle touch device is formed when said injection rod is unitarily coupled by a tie bar across said interval to said hydraulic device.

5. The in-line injection molding machine for low-melting point metallic material according to claim 1, wherein a driving device for said agitating member is constituted by an electric motor, which is provided on a sides of a supporting legs of the melting cylinder so as to move together with said melting cylinder.

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GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313